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Indian Standard

VISCOSITY CLASSIFICATION FOR INDUSTRIAL LIQUID LUBRICANTS

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Indian Standard

VISCOSITY CLASSIFICATION FOR INDUSTRIAL LIQUID LUBRICANTS

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Indian Standard
VISCOSITY CLASSIFICATION FOR INDUSTRIAL LIQUID LUBRICANTS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 12 March 1980, after the draft finalized by the Lubricants and Related Products Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

0.2 This Indian Standard has been adopted from ISO 3448-1975 'Industrial liquid lubricants—ISO Viscosity classification' in order to meet the immediate needs of the industry by providing a classification of liquid lubricants according to viscosity grades. The purpose of this system is to establish a series of definite kinematic viscosity levels so that lubricant suppliers, lubricant users, and equipment designers will have a uniform and common basis for designating or selecting industrial liquid lubricants according to the kinematic viscosity required in a particular application.

0.3 It is desirable that any classification system of this nature should cover the entire range of kinematic viscosities of liquid lubricants normally used; at the same time, the number of kinematic viscosity grades within the classification should be limited. A continuous system, in which any lubricant within the viscosity range could be given a grade number, was first considered, but it was recognized that this would involve either an unduly large number of grades or an unduly wide range of permitted kinematic viscosities for each grade.

0.4 For the classification to be of direct use in engineering design calculations, in which the kinematic viscosity of the lubricant is only one of the parameters, it is desirable that the viscosity grade width be not more than 10 percent on either side of the nominal value. This would reflect a similar order of uncertainty in calculation to that imposed by dimensional manufacturing tolerances. This limitation, coupled with the requirement that the number of viscosity grades should not be too large, has led to the adoption of a discontinuous system with gaps between the viscosity grades.

0.5 The reference temperature for the classification should be selected to be reasonably close to average service experience. It should also closely relate to other selected temperatures used to define properties, such as viscosity index which can aid in defining a lubricant. A study of a series of possible temperatures indicates that 40°C is particularly well suited for purposes of industrial lubricant classification as well as for other properties.

This viscosity classification is consequently based on kinematic viscosity at 40°C.

0.6 The viscosity designations are identical with those in the wellknown ASTM/ASLE and BSI classifications. These classifications were based on a temperature of 37·8°C. It has been decided to phase out the use of this temperature gradually. It is recommended that this should be achieved by allowing a limited period of up to one year during which systems using 40°C and 37·8°C would be equally acceptable. It is intended that after this interim period, the classification based on 40°C will be the only recognized classification. It should be noted that for most lubricants the difference between the kinematic viscosities at 37·8°C and 40°C will be approximately 10 percent (*see* Appendix A). This difference is recognized as being of no practical significance in industrial lubrication.

0.7 Although this ISO classification is bound to lead to a number of existing lubricants (possibly including some at present widely used) not being accommodated within the classification, there is nothing to prevent the continued use of such products by agreement between the supplier and the consumer. The kinematic viscosities of such out of classification oils should, however, be determined at 40°C. It is expected, however, that lubricant producers will move towards the adjustment of their products so that each product will fall within one of the viscosity grade designations; that users will, in the interests of rationalization and the reduction of the number of oils which they use, call increasingly for lubricants covered by the classification; and that machine and equipment manufacturers and their component suppliers will take due note of the classification in the design stages and in their lubricant viscosity recommendations.

0.8 It is not expected that liquid lubricants of every quality, or those designed for very specific purposes, should necessarily be available within every viscosity grade of this standard.

NOTE — The Society of Automotive Engineers (USA) established many years ago standards for identifying and/or classifying the viscosity characteristics of lubricants used in automotive engines and gears. Their systems, which are widely known and used in most countries of the world, are based on the measurement of kinematic viscosity at temperatures that are considered to represent the normal operating range; the nomenclature used is for example SAE 10 W, 20 W and 30 for engine oils (SEA J 300a) and SAE 75 W, 90 and 140 for gear oils (SAE J 306a). It should be noted that this ISO classification for industrial liquid lubricants is not intended to replace either of the SAE systems; on the other hand the latter systems, while they have desirable features for automotive lubricants, are not suitable for extension to industrial lubricants in general.

0.9 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS: 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard establishes a system of viscosity classification for industrial liquid lubricants and related fluids. This includes mineral oils used as lubricants, hydraulic fluids, electrical oils and for other applications.

The usual method for kinematic viscosity determination is that specified in IS: 1448[P: 25]-1976*, but this may give anomalous results when used with non-Newtonian fluids (that is, those whose coefficient of viscosity varies significantly with rate of shear). For such fluids it is, therefore, important to state the particular method by which viscosity has been determined.

1.2 It is also recognized that there may be some pure chemicals and naturally occurring products, used as lubricants, which may not fall within this classification.

2. CLASSIFICATION

2.1 The classification defines 18 viscosity grades in the range 2 cSt† to 1 500 cSt at 40·0°C; this covers, as far as petroleum-based liquids are concerned, approximately the range from kerosine to cylinder oils.

2.2 Each viscosity grade is designated by the nearest whole number to its mid-point kinematic viscosity in centistokes at 40·0°C, and a kinematic viscosity range of ±10 percent of this value is permitted. The 18 viscosity grades with the limits appropriate to each are given in Table 1.

2.3 The classification is based on the principle that the mid-point kinematic viscosity of each grade should be approximately 50 percent greater than that of the preceding one. The division of each decade into six equal logarithmic steps provides such a system and permits a uniform progression from decade to decade, but in order to provide simple numbers the logarithmic series has been rounded off. The maximum deviation of the mid-point viscosities from the logarithmic series is 2·2 percent.

2.4 The classification implies no quality evaluation, and provides information only on the kinematic viscosity at the reference temperature of 40·0°C. The kinematic viscosities at other temperatures depend on the viscosity/temperature characteristics of the lubricants, which are usually reported as viscosity/temperature curves or stated in terms of viscosity index (VI).

2.5 The kinematic viscosities of the same lubricants defined by this standard, but identified at other temperatures customarily used in some countries, are shown in Appendix A. Three values of viscosity index have been used. These are given here only for the purpose of general guidance in understanding or adoption of this standard.

---

*Methods of tests for petroleum and petroleum products: Determination of kinematic and dynamic viscosity (*first revision*).

†1 cSt = 1 $mm^2/S = 10^{-6} m^2/s$.

3. TRANSITION PERIOD

3.1 For a period of not more than one year following approval of this standard, the classification of lubricants at 37·8°C will be regarded as acceptable. Following this interim period, 40°C shall be the only recognized classification system temperature.

4. DESIGNATION

4.1 The following wording shall be used to designate a particular viscosity grade:

ISO viscosity grade ...... (ISO 3448/IS......) which may be abbreviated to:

ISO VG......

TABLE 1 ISO VISCOSITY CLASSIFICATION

(*Clause* 2.2)

ISO Viscosity Grade	Mid-point Kinematic Viscosity cSt at 40·0°C	Kinematic Viscosity Limits at 40·0°C	
		Min	*Max*
(1)	(2)	(3) cSt	(4) cSt
ISO VG 2	2·2	1·98	2·42
ISO VG 3	3·2	2·88	3·52
ISO VG 5	4·6	4·14	5·06
ISO VG 7	6·8	6·12	7·48
ISO VG 10	10	9·00	11·0
ISO VG 15	15	13·5	16·5
ISO VG 22	22	19·8	24·2
ISO VG 32	32	28·8	35·2
ISO VG 46	46	41·4	50·6
ISO VG 68	68	61·2	74·8
ISO VG 100	100	90·0	110
ISO VG 150	150	135	165
ISO VG 220	220	198	242
ISO VG 320	320	288	352
ISO VG 460	460	414	506
ISO VG 680	680	612	748
ISO VG 1 000	1 000	900	1 100
ISO VG 1 500	1 500	1 350	1 650

APPENDIX A

(*Clauses* 0.5 *and* 2.5)

ISO VISCOSITY CLASSIFICATION WITH CORRESPONDING KINEMATIC VISCOSITIES AT VARIOUS TEMPERATURES FOR DIFFERING VISCOSITY INDICES

ISO Viscosity Grade	Kinematic Viscosity Range	Approximate Kinematic Viscosity at Other Temperatures for Different Values of Viscosity Index								
		Viscosity Index=0			Viscosity Index=50			Viscosity Index=95		
	cSt at 40°C	cSt at 20°C	cSt at 37·8°C	cSt at 50°C	cSt at 20°C	cSt at 37·8°C	cSt at 50°C	cSt at 20°C	cSt at 37·8°C	cSt at 50°C
ISO VG 2	1·98-2·42	(2·82-3·67)	(2·05-2·52)	(1·69-2·03)	(2·87-3·69)	(2·05-2·52)	(1·69-2·03)	(2·92-3·71)	(2·06-2·52)	(1·69-2·03)
ISO VG 3	2·88-3·52	(4·60-5·99)	(3·02-3·71)	(2·37-2·83)	(4·59-5·92)	(3·02-3·70)	(2·38-2·84)	(4·58-5·83)	(3·01-3·69)	(2·39-2·86)
ISO VG 5	4·14-5·06	(7·39-9·60)	(4·38-5·38)	(3·27-3·91)	(7·25-9·35)	(4·37-5·37)	(3·29-3·95)	(7·09-9·03)	(4·36-5·35)	(3·32-3·99)
ISO VG 7	6·12-7·48	(12·3-16·0)	(6·55-8·05)	(4·63-5·52)	(11·9-15·3)	(6·52-8·01)	(4·68-5·61)	(11·4-14·4)	(6·50-7·98)	(4·76-5·72)
ISO VG 10	9·00-11·0	20·2-25·9	9·73-12·0	6·53-7·83	19·1-24·5	9·68-11·9	6·65-7·99	18·1-23·1	9·64-11·8	6·78-8·14
ISO VG 15	13·5-16·5	33·5-43·0	14·7-18·1	9·43-11·3	31·6-40·6	14·7-18·0	9·62-11·5	29·8-38·3	14·6-17·9	9·80-11·8
ISO VG 22	19·8-24·2	54·2-69·8	21·8-26·8	13·3-16·0	51·0-65·8	21·7-26·6	13·6-16·3	48·0-61·7	21·6-26·5	13·9-16·6
ISO VG 32	28·8-35·2	87·7-115	32·0-39·4	18·6-22·2	82·6-108	31·9-39·2	19·0-22·6	76·9-98·7	31·7-38·9	19·4-23·3
ISO VG 46	41·4-50·6	144-189	46·6-57·4	25·5-30·3	133-172	46·3-56·9	26·1-31·3	120-153	45·9-56·3	27·0-32·5
ISO VG 68	61·2-74·8	242-315	69·8-85·8	35·9-42·8	219-283	69·2-85·0	37·1-44·4	193-244	68·4-83·9	38·7-46·6
ISO VG 100	90·0-110	402-520	104-127	50·4-60·3	356-454	103-126	52·4-63·0	303-383	101-124	55·3-66·6
ISO VG 150	135-165	672-862	157-194	72·5-86·9	583-743	155-191	75·9-91·2	486-614	153-188	80·6-97·1
ISO VG 220	198-242	1 080-1 390	233-286	102-123	927-1 180	230-282	108-129	761-964	226-277	115-138
ISO VG 320	288-352	1 720-2 210	341-419	144-172	1 460-1 870	337-414	151-182	1 180-1 500	331-406	163-196
ISO VG 460	414-506	2 700-3 480	495-608	199-239	2 290-2 930	488-599	210-252	1 810-2 300	478-587	228-274
ISO VG 680	612-748	4 420-5 680	739-908	283-339	3 700-4 740	728-894	300-360	2 880-3 650	712-874	326-393
ISO VG 1 000	900-1 100	7 170-9 230	1 100-1 350	400-479	5 960-7 640	1 080-1 330	425-509	4 550-5 780	1 050-1 290	466-560
ISO VG 1 500	1 350-1 650	11 900-15 400	1 660-2 040	575-688	9 850-12 600	1 640-2 010	613-734	7 390-9 400	1 590-1 960	676-812

NOTE — Values in parentheses have been derived by extrapolation and are approximate.

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